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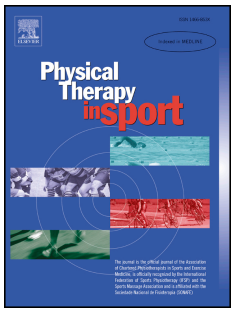

Practices & attitudes towards recovery in elite Asian & UK adolescent athletes

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Title:

Practices & Attitudes towards Recovery in Elite Asian & UK Adolescent Athletes

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Recovery attitudes in adolescent athletes

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ABSTRACT

Objectives: Assess current practice and attitudes towards recovery in adolescent athletes.

Design: Questionnaires were administered either via print or online questionnaire.

Participants: Athletes and coaches from within Asia were surveyed (n=112 & 53), with a comparative sample in the UK (n=53 & 8).

Main Outcome Measures: The approaches and attitudes to recovery in both training and competition.

Results: Adolescent athletes perceive a variety of recovery modalities as important, though prioritise active recovery, nutrition and sleep. Attitudes towards recovery differed between athletes in Asia and the UK with respect to the perceived benefits of: sleep (96% believe in it in the UK *v* 69% in Asia, $p<0.01$); nutrition (92 *v* 58%, $p<0.01$); and active recovery (70 *v* 52%, $p=0.03$). The number of recovery techniques used with Asian athletes was higher after training ($p=0.009$) and competition ($p<0.01$). Asian athletes rely more on 'feel' to justify interventions.

Conclusions: There was a major disconnect amongst athletes' belief in particular strategies and their behaviours. The results of this study show the need for educating coaches and athletes.

Key Words
Belief; Practice; Youth; Survey

INTRODUCTION

The principles of overload and supercompensation are the basis of any periodised training programme. Suitable recovery periods need to be programmed in combination with practices that are proportional to both the training load and fatigue level (Hausswirth & Mujika, 2013). Recovery has been practically defined as "the whole set of processes that result in an athlete's renewed ability to meet or exceed a previous performance" (Hausswirth & Mujika, 2013). While the use of recovery practices are commonplace in diverse athletic populations, recovery remains an under-researched area relative to training studies, with many practices not fully supported by under-pining evidence. There is no definition of the most ‘appropriate’ modality, protocol and timing according to the level of the athlete and their training goals (Barnett, 2006). Furthermore, there has been little investigation into the attitudes and beliefs associated with the choice and use of these practices in diverse socio-cultural environments across the world. Prescribed recovery strategies may interfere with the planned training adaptations in an acute or chronic context and so caution should surround their use. Despite this, many coaches/practitioners implement recovery strategies without truly assessing the cost-benefit of such approach. It is also true that very few data are available on prolonged implementations of recovery strategies as compared to the amount of studies conducted on the acute physiological responses of most modalities. Recent work in Australian Football players over the course of a season approached the

issue, assessing perceptual measures of recovery and physiological tests conducted after games (Bahnert, Norton, & Lock, 2013) . Typically, players who chose cold immersion, stretching and compression garments as their strategy reported a greater perceived recovery. However, no relationship was evident between recovery outcomes measured via objective physiological measures and the choice of recovery methods used (Bahnert et al., 2013). It is therefore clear that research should include perceptual measures of recovery as part of a comprehensive approach to athlete monitoring (Saw, Main, & Gastin, 2016), but also that research findings are somewhat limited.

Previous work surveying 890 South African team sport athletes of mixed gender (57% men), showed that the top 3 recovery preferences, regardless of playing level or gender, were, in order of preference: sleep, fluid replacement and prayer (Venter, 2012). What is not clear is how the athletes made the choices and preferences for these modalities. In particular, whether individual preference or coaching staff's advice was the basis for the choice. While one of the top modalities was prayer, it has been suggested that, with regards to recovery modalities, focus is often placed on physical therapies and not so much on psychosocial aspects of recovery (Kellmann, 2009).

It is known that psychosocial and mental stress can impact physiological processes (Mehta & Agnew, 2012) and that a subject's belief of the efficacy of an intervention can

influence subsequent responses (Beedie & Foad, 2009). Perceptual recovery has been demonstrated in participants after running to exhaustion on a treadmill (Coffey, Leveritt, & Gill, 2004), undergoing cycling activity (Stanley, Buchheit, & Peake, 2012) and within a team setting (Cook & Beaven, 2013) utilising contrast and cold water immersion techniques. Somatic reasons integrate with psychological and sociological factors in athletes' minds (van Wilgen & Verhagen, 2012) and can influence their behaviours. Negative subjective impressions of a recovery intervention have been shown to impact negatively on its effectiveness (Higgins, Heazlewood, & Climstein, 2011).

Integrating athletes' belief systems into their recovery, or developing education programmes around a chosen method, may contribute to planning more adequate interventions and aid selection strategies for implementation (van Wilgen & Verhagen, 2012). The commonly-hypothesised physiological benefits surrounding cold water immersion were challenged using a placebo-based approach that found improved ratings of readiness for exercise, pain and vigour after a high-intensity interval session (Broatch, Petersen, & Bishop, 2014). The effectiveness and importance of placebo as a therapeutic intervention in medicine has been well reviewed elsewhere (Beedie & Foad, 2009) and should be also considered positively in a sporting environment (Bérdi, Köteles, Hevesi, Bárdos, & Szabo, 2014).

Studies looking at the recovery modalities applied and the perception of their effectiveness in adolescent populations are especially limited. Adolescent athletes across the world experience diverse environmental challenges as well as different socio-cultural influences. How athletes choose to recover and the advice they receive about recovery may be affected by the immediate environment and climatic conditions, which in turn affects their beliefs.

If recovery or training itself is not planned sufficiently then adolescent athletes can develop staleness or overtraining symptoms (Kenttä, Hassmén, & Raglin, 2001), or indeed too much recovery may negate the homeostatic disruption required to induce adaptations. Therefore, the purpose of this study was to establish current practice and attitudes towards recovery in adolescent athletes in Asian and UK populations as the first steps, of describing the problem, in the model of applied research for the sport sciences (Bishop, 2008). This approach encompasses comparisons between athletes and coaches and both their practices and beliefs.

METHODS

Experimental approach to the problem

With a longer-term aim of designing and implementing intervention research on recovery practices for adolescent athletes, this initial study was primarily descriptive in nature, including exploration of some associations and differences, in order to characterise the current state of play in this field and to develop specific knowledge gaps and hypotheses for future studies, according to the model proposed by Bishop (2008). As the purpose of the study was to establish current practice and attitudes towards recovery in adolescent athletes, a survey combined of open and closed questions was used to maximise the response rate, yet enable more detail (Thomas, Nelson, & Silverman, 2011). The open questions enabled athletes and coaches to express opinions and elaborate on beliefs (Portney & Watkins, 2009).

The survey was administered to a convenience sample of subjects in Asia who were included if they: trained in the X facility regularly or visited for a training camp; were coaches of adolescents or were by the UN definition an adolescent athlete (aged 12-18 years). A comparative sample from the UK was recruited via governing bodies and coaches within the UK sporting system who work with adolescent athletes. The principal researcher administered the survey using a printed-paper and pencil version for the Asian cohorts and an email invitation to an online questionnaire (Google Docs)

for the UK-based cohort. The subjects were recruited over a 9-month period from July 2014 to March 2015. They were offered the chance to complete the survey voluntarily but at no time was it compulsory. The survey consisted of 16 questions split into four sections; subject demographics, current practice, recovery beliefs and evidence for recovery (table 1). Typically, the survey took less than 15 minutes to complete. Any questions arising from culture or understanding were typically answered at completion as the principal investigator administered each questionnaire in person. The ability to clarify for the online group was available via email but was never taken. This was likely as the questions were administered in English. If needed the principal investigator followed up in person or via telephone as appropriate if there was a need for clarity from any answers provided (i.e. differing perception around recovery modalities or unclear answers).

Subjects

Four separate groups took part in the study. The Asian cohort consisted of groups 1-3 while the UK cohort consisted of group 4.

1. Arab athletes and their coaching teams based at the X in the Middle East, (n=51 athletes & n=6 coaches);

2. Members of an Asian Olympic Youth Athletics Camp which was held at the academy (n=48 athletes & 45 coaches);
3. Malaysian Youth national squash teams training at the academy (n=13 athletes & 2 coaches);
4. An age-matched cohort of Olympic sport athletes of similar ages from the UK sourced via author contacts (n=53 athletes & 8 coaches). Similar to the Asian athletes all those from the UK had youth level representation for their country.

Athlete's ages ranged from 13-18 years with 60% male participants across all groups. Coaches' ages were not recorded but the sample was 90% male across all groups. For the purposes of analysis, the Asian groups were combined and assessed against the UK cohort. Ethical permission was granted by the University of Edinburgh Ethics Committee to complete the study as described.

Procedures

Research Instrument

The questionnaire comprised of 16 questions in four sections – *demographic information, current practice, beliefs* and *evidence*. Questions utilised five open and eleven closed answers, the questionnaire is given in full in table 1. The survey was discussed amongst two of the authors with over 30 years of combined experience in the

fields of sport science and coaching, and piloted with a group of 10 boys from X and 5 practitioners who worked with them before use. Following review of pilot testing data minor changes were made to the question wording to ease understanding and to ensure the emphasis was correct to native and non-native English speakers.

Demographics

In the first four questions (table 1) the subject's name, position (athlete or coach), gender and their experience level within their chosen sport was assessed. In terms of experience, the subjects choose the appropriate option from 5 categories (table 1).

Open Questions

The first of the open-ended questions asked the subject which sport they competed in (question 5). The next concerned the participant's current practice of recovery post training and competition (questions 6 & 7). The fourth was an optional expansion on the limited response of *experience*, *evidence* or *both* for why they did what they did (question 9). In the final evidence section, subjects were asked to state how they knew they had recovered (question 16).

Closed questions

The first closed question asked participants to choose why they did what they did currently to recover from a choice of *evidence, experience or both* (question 8). Subsequently they were asked to rate their opinion on a range of common recovery methods' effectiveness (sleep, nutrition, compression, active recovery, contrast baths and ice baths; questions 10 – 15). A 5-point scale of *no effect, minor, neutral, moderate* or *major* was used to reflect the subjects' beliefs. In some cases, responses were reduced to positive and negative nominal levels (Lavrakas & Battaglia, 2008) to avoid any bias from central tendency, acquiescence or social desirability.

*** TABLE 1 NEAR HERE***

Statistical Analysis

The absolute values of responses were calculated from the information contained in the returned questionnaires. For the open questions the answers were subsequently coded on completion of all questionnaires by the lead author into subcategories for subsequent analysis of the frequency of occurrence. For example, in terms of current practice this accounted for the particular recovery strategies mentioned by all participants. Coding accounted for all answers given across the sample groups. Closed questions were assigned a numerical value based on their response and assessed as continuous data. Analysis occurred using Minitab 17.0 (Pennsylvania, USA). In the event of ambiguity

follow-up questions were asked to confirm the subject's intention. No difference was found between the three Asian subgroups and so these were combined for comparison to the UK cohort, also to ascertain any difference between Western vs non Western athletes. Differences between groups were assessed between frequency of responses using the chi-square test (χ^2), one-way ANOVA or t-tests of the proportional data as appropriate. A multivariate analysis was made to cluster the type of recovery groups. Alpha was set at $p<0.05$.

RESULTS

Demographics

Coaches

Across the Asian cohort, the coaches' experience was predominantly in the 5-10 year category. Of the UK coaches' cohort surveyed, 38% had 5-10 years' experience and 25% had more than 10 years' experience. There were no significant differences between the levels of experience in the coaches between cohorts when grouped into less than 3 years, 3-5 and more than 10 ($p=0.27$, $X^2=2.65$).

Athletes

For the local Arab athletes from the academy 34% had 3-5 years' training experience with 49% citing 5-10 years in their sport. The Asian Olympic Camp dealt with athletes of a similar age to the academy athletes (13-18 years) but their experience levels were

more uniform with 27% having 3-5 years' experience and 25% less than 18 months in their sport. The Malaysian athletes were mainly in the 5-10 year training experience bracket (69%). Within the UK the majority of athletes reported having more than 10 years within their sport (45%).

Despite the athletes being of a similar age range there was a significant difference in training experience reported in the two population cohorts. Figure 1 shows the distribution of experience levels for both athletes and coaches.

FIGURE 1 NEAR HERE

Effectiveness

There were significant differences between the beliefs of athletes as to the effectiveness of particular recovery techniques across the different populations (table 2). Belief of effectiveness was assessed via closed questions assessing the athlete's perceived benefit of a technique. The answers were assigned a numerical value (5 = most benefit, 1 = least). If the athlete rated the effectiveness as 4 or 5 then this was coded as a *benefit* otherwise it was coded as *no benefit*.

Athletes from the UK have significantly greater belief that sleep can benefit their recovery (i.e. a higher frequency of positive beliefs; $p<0.01$, $X^2=15.51$). Within Asia

there is limited belief in the benefit of nutrition for recovery and this is significantly different to the perception of the athletes outside of Asia ($p<0.01$, $X^2=19.77$). There were marked differences in active recovery ($p=0.03$, $X^2=4.56$) between Asia and the UK. The belief in the effects of compression garments and ice baths were similar across the populations. There were no significant differences between coaches' beliefs across the two population groups.

TABLE 2 NEAR HERE

Belief & Use

Use

The responses from questions 6 and 7 were coded to assess the frequency of use of various recovery techniques in training and competition (table 3). There were no differences between athletes or coaches in the use of active recovery, swimming, massage, nutrition, psychology or training between the two populations. There were differences for the reported use of sleep during training ($p<0.01$, $X^2=22.44$) and competition periods ($p<0.01$, $X^2=12.26$) for athletes, with a typically greater prevalence of use of sleep as a recovery modality in Asia. After competition there were athlete differences in the use of cold ($p<0.01$, $X^2=39.58$) and hot ($p=0.001$, $X^2=10.19$) therapies with a greater prevalence of use outside of Asia. The reliance on rehydration for recovery was greater for Asian athletes after training ($p=0.004$, $X^2=8.07$) and

competition ($p=0.01$, $X^2=6.19$). The use of compression garments was extremely limited in Asia in comparison to the UK in both training ($p<0.01$, $X^2=30.47$) and competition ($p<0.01$, $X^2=35.28$). This was also the case for foam rolling with limited uptake in Asia. The use of rest to recover after competition was higher in UK athletes ($p=0.02$, $X^2=5.37$). Stretching was the only modality that differs in use between both athletes and coaches across both training and competition. In all cases, the use of this recovery modality in training was higher in the UK.

TABLE 3 NEAR HERE

Belief

Looking at more than simply the use of modalities, we assessed if the athlete 'believed' in a recovery technique, (i.e. they rated its effectiveness as *moderate* or *major* in previous questions), in combination with if they stated that they used this technique to recover from training or competition (table 4). This gave four possible combinations of the athlete believing in the method and using it (+/+), the athlete not believing in the method and not using it (-/-), believing in it and not using it (+/-) or finally, not believing in it but using it anyway (-/+).

TABLE 4 NEAR HERE

For athletes there was disconnect between the belief and the stated use of sleep. While all athletes sleep, those that rated it highly as a recovery strategy did not tend to adopt sleep as a recovery modality in the UK population. The trend was slightly closer to the beliefs in Asia. There were differences between the patterns of belief and adoption for athletes who are believers ($p=0.001$, $X^2=11.88$) and non-believers ($p=0.001$, $X^2=17.25$) between the two populations. Nutritional strategies showed a low adoption despite the belief of the athletes (28% & 43% in Asia and UK respectively). There was a difference between different populations in the nutritional non-believers ($p=0.007$, $X^2=8.63$).

Despite a belief in compression, very few athletes adopted this strategy for recovery (1% & 21% for Asia & UK) and this differed across the two populations. There was also a difference in non-believers with almost a fifth of the UK population using compression despite a low belief in its effectiveness. Around a third of believers in each population actually make use of active recovery and this was consistent across both populations with the non-believers not adopting the technique.

There was limited adoption of contrast baths among believers and non-believers of the technique and the patterns differed across population groups. A greater proportion of believers reported to utilise ice in their recovery strategies in the UK population in

comparison to the Asian group. In the Asian group less than 10% of the believers utilised this as a strategy.

Assessment of recovery

From the coded responses to questions 6 & 7 we assessed the number of unique recovery techniques each athlete used. For Asian athletes the total number of techniques used was lower after training, (2.25±1.25 *v* 3.02±1.87 (mean±SD; p=0.009)) and competition (1.93±0.97 *v* 3.51±1.46, p<0.01) than their UK counterparts. The coded answers as to how athletes and coaches assessed their recovery (question 16) also provided some differences between the groups. More athletes utilised flexibility in the UK to assess their recovery (p=0.03, X^2=4.72). More coaches used heart rate to assess recovery in Asia (p=0.009, X^2=6.84). There were differences in the use of psychological interventions, questionnaires and simple observation of behaviours across groups to assess recovery for athletes but not for coaches.

Reasons

Having coded the open answers as to why athletes recover the way they do, (question 9), cluster analysis of the combination of techniques suggested that recovery attitudes can be clustered into four main groups. These can be summarised as; Rest (using nutrition, rest & sleep predominate), Combination (active, nutrition & sleep), Active (sleep & active recovery) and Stretch (nutrition, stretch & sleep). Within Asia, the

Combination approach dominates (95%) whereas in the UK it is Rest (25%; X^2 6.97, *p*=0.03). The reasons why these athlete groups do what they do (question 8) differs, with 45% favouring experience in Asia and 60% in the UK favouring a combination of evidence and experience (X^2 7.99, *p*=0.018). Looking at the frequency of language in the open answers visually displays the frequency of certain words so we can visualise how athletes know they have recovered (figure 2).

FIGURE 2 NEAR HERE

Ways / Means

Analysis of the frequency of words used in open answers suggests in general, behaviour in Asia is ruled by what the coach says and in the UK by educated self-decision (figure 3). There was a difference in the proportion of the use of the word 'coach' or its derivatives between the two populations (question 16). In Asia the use was proportionally higher by 2.6% (p<0.001, 95% CI 1.2 – 4.0%). Words that indicated taking responsibility for self (i.e. I, Me, My) did not differ between populations (p=0.33). There are exceptions to this with individual recovery practices (i.e. compression in the UK is utilised by 17% of the population who do not believe in it) but looking at recovery globally shows this difference.

FIGURE 3 NEAR HERE

DISCUSSION

The main aim of the present study was to assess how adolescent athletes perceived and used various recovery modalities and to provide a first descriptive step into establishing the current knowledge of both athletes and coaches. There were different beliefs in the benefits of sleep, nutrition, active recovery and compression, but it seems that regardless of their background adolescent athletes favour active recovery, nutrition and sleep. They may do this for different reasons, as coaches in Asia are seen as a respected elder or a teacher (Nangalia & Nangalia, 2010). In the UK they may still be influencers on the choice of recovery modality, but it seems equally likely to be support staff or peers influencing athletes than just the coach.

It is also possible that cultural barriers exist to prevent the adoption of some recovery practices despite a belief in its efficacy (i.e. nutrition may be compromised as food preparation opportunities for athletes in Asia are compromised as there is a reliance on parents or maids to prepare meals, or poor nutritional choices may be more convenient). Equally, availability or access to certain equipment may be the issue, as in the case of foam rolling, or it may be that education of athletes and coaches may affect their choices. This suggests there is a need to understand the evidence-base for current recovery practices in an adolescent population.

Adolescent athletes in this study came mainly from an elite sports academy. These academy-aged athletes are typically chosen as they were the best athletes in their country for their sport. They still have a young training age, so have not been involved in a performance programme for a concerted period, and so could not yet be considered 'elite'. Athletes within the UK tended to have more training and competition experience, which may reflect early specialisation in one sport or a lifetime of sport involvement across differing activities that may reflect the differing socio-cultural conditions. The opposite was true of coaches, most of whom had high levels of experience; 83% of the coaches at the sports academy having more than 10 years' experience and so met one of the criteria of being an 'expert coach' (Nash & Sproule, 2009). In the Asian Olympic Camp group, only 51% of coaches had more than 10 years' experience.

These highly experienced coaches likely impart their beliefs upon their athletes as they work with and educate them. Previous work has shown that the choice of recovery modality in team sport players is influenced by coaches and support staff (Wyk, 2009). The majority of athletes and coaches in the current study came from individual sports (72%). Within Asia the majority of athletes stated that they knew they had recovered due to their coach telling them this was the case, in stark contrast to current

recommendations regarding adult athlete monitoring, where the athlete's subjective perception is potentially most reliable (Saw et al., 2016).

This may be a reflection of the coach-athlete relationship. This dyad is important to facilitate technical and physical competencies (Jackson, Beauchamp, & Knapp, 2007). Among young athletes, perceptions of high quality interactions with coaches are related to a greater sport enjoyment (Fraser-Thomas, Côté, & Deakin, 2008). It has been shown that a high degree of confidence in the other person's capabilities predicted enhanced commitment for the other member of the coach or athlete. Therefore, the athlete may take what the coach says as the truth i.e. telling them they have recovered so the athlete believes it, as a lower perception of muscle soreness could have a positive effect on the player's work attitude during subsequent training sessions (Rey, Lago-Peñas, Lago-Ballesteros, & Casáis, 2012). This is demonstrated by the answer of one athlete to question 8, how do you know you have recovered; *"Coach told me"*. Alternatively, coaches may champion that the athlete is recovered as they used a particular modality and so reinforce its use by the athlete. One athlete stated, *"I have a paper from my coach with a list of things to do i.e. stretch, jog etc. If I do them I feel good"*.

At some levels (e.g., elite competitors), athletes may not occupy such a subordinate position and may therefore have greater autonomy to decide what is right for them in

terms of training and/or recovery (Jackson, Grove, & Beauchamp, 2010). This may though be contrary to research that shows controlling coaches disrupt athletes experiencing fulfilment of their basic psychological needs (Balaguer et al., 2012). This may be as they are coercive, and authoritarian in imposing a preconceived way of thinking upon athletes (Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010). This may also be a self-perpetuating phenomenon with coaches 'doing what they have always done' which is highlighted by the majority of self-directed learning occurring with other coaches and colleagues (Stoszkowski & Collins, 2015) and a typically negative experience from formal learning (~98%).

Previous research has shown that adult athletes also value sleep (Venter, 2012) as one of the main methods of recovery. Within the literature there are suggestions that athletes need around 10 hours each night to recover, exceeding the recommendations for healthy adults of around 8 hours (Fullagar et al., 2014). Recent work has suggested that due to training schedules and life constraints athletes actually sleep far less than either of these recommendations (Sargent, Halson, & Roach, 2014). This could be due to stress around competitions (Erlacher, Ehrlenspiel, Adegbesan, & El-Din, 2011; Juliff, Halson, & Peiffer, 2015). In adolescent athletes there is limited information available in the literature. It has been shown that less than 7 hours of sleep can increase the risk of developing an upper respiratory tract infection in healthy individuals nearly 3 times

relative to those with more than 8 hours of sleep (Cohen, Doyle, Alper, Janicki-Deverts, & Turner, 2009) and in adolescent athletes less than 8 hours of sleep increases the injury risk 1.7 times (Milewski et al., 2014). Unpublished data from the X has shown that across sports, training camps and the home environment adolescent male athletes average around seven and a half hours sleep each night. This may reflect that athletes in Asia don't use sleep as a recovery strategy despite believing in it (table 4). If this is representative of all adolescent athletes in Asia then this would suggest that they are potentially at an increased risk of developing injury and illness.

The placebo effect may contribute to determining the perceived improvement in performance coming from any recovery modality. Over 80% of athletes surveyed believe that placebos could affect sporting performance (Beedie & Foad, 2009; Bérdi et al., 2014). It has been postulated that a conditioning effect strengthens the attitude towards placebos (Bérdi et al., 2014). If this is true, it may be that despite any limited evidence for an intervention used for recovery if the athletes believe it to be of benefit this may be the case.

Limitations

It is difficult to provide a measure of honesty or accuracy of the subject responses. This would improve future research in this area – perhaps by observation of behaviours as a

follow-up to the questionnaire. This study focused on a subset of popular recovery techniques while others are available and used by athletes. Future investigations could investigate other, less popular, recovery techniques. Taking the participants' age may help assessment directly related to age and stage of development, in this study we simply recruited within an age bracket. Future research from a large sample may benefit from insights into the differing responses in early and late adolescence that may reflect pubertal and educational changes, as well as exploring further cultural differences across the world.

Conclusion

While adolescent athletes prioritise active recovery, nutrition and sleep in their beliefs their behaviour does not always match their beliefs, at times there is a major disconnect between the two. The results of this study suggest that there is a need to educate both athletes and coaches on the benefits of different facets of recovery and to examine the coaches' role in dictating recovery behaviours to adolescents.

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TABLE LEGENDS

Table 1: Questionnaire in full with question type

Table 2: Beliefs about common recovery techniques by population group

Table 3: Adoption of particular recovery strategies by athletes

Table 4: Belief and use of recovery strategies

FIGURE LEGENDS

Figure 1: Experience levels within their sport of athletes and coaches

Figure 2: Why athletes recover the way they do (Asia on left, UK on right). This word cloud is based on the frequency of responses to the *open* questions. The more times a word is used the larger it appears.

Figure 3: How athletes know they have recovered (Asia on left, UK on right). This word cloud is based on the frequency of responses to the *open* questions. The more times a word is used the larger it appears.

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Questionnaire Content
Demographics
1. Name: (Open)
2. Position: Coach | Athlete (Dropdown)
3. Gender: Male | Female (Checkbox)
4. Experience in current position (i.e. years as a coach or athlete)?: <18 mths | 18 mths – 3 years | 3 – 5 years | 5 – 10 years | >10 years (Checkbox)
Details
5. Which sport & discipline do you primarily coach/compete in?: (Open)
6. What do you / your athletes currently do to recover from training?: (Open)
7. What do you / your athletes currently do to recover from competition? (Open)
8. Why do you or your athletes do this?: Experience | Evidence | Both (Checkbox)
9. Please expand on the answer above: (Open)
Beliefs
10. How would you rate the effectiveness of sleep on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)
11. How would you rate the effectiveness of nutrition on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)
12. How would you rate the effectiveness of compression on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)
13. How would you rate the effectiveness of active recovery on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)

14. How would you rate the effectiveness of contrast baths on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)
15. How would you rate the effectiveness of ice baths on recovery?: No effect | Minor effect | Neutral | Moderate Effect | Major Effect (Checkbox)
Evidence
16. How do you know you or your athletes have recovered? (Open)

Table 1: Questionnaire in full with question type

		Asia				UK			
		Athlete		Coach		Athlete		Coach	
		Response count	*%*	*Response count*	*%*	*Response count*	*%*	*Response count*	*%*
Sleep*	No Benefit	*32*	31%	*6*	11%	*2*	4%	*0*	0%
	Benefit	*70*	69%	*47*	89%	*51*	96%	*8*	100%
Nutrition*	No Benefit	*43*	42%	*13*	25%	*4*	8%	*0*	0%
	Benefit	*59*	58%	*40*	75%	*49*	92%	*8*	100%
Compression	No Benefit	*71*	70%	*27*	51%	*30*	57%	*6*	75%
	Benefit	*31*	30%	*26*	49%	*23*	43%	*2*	25%
Active‡	No Benefit	*49*	48%	*13*	25%	*16*	30%	*0*	0%
	Benefit	*53*	52%	*40*	75%	*37*	70%	*8*	100%
Contrast	No Benefit	*47*	46%	*27*	51%	*30*	57%	*5*	63%
	Benefit	*55*	54%	*26*	49%	*23*	43%	*3*	38%
Ice	No Benefit	*58*	57%	*18*	34%	*22*	42%	*4*	50%
	Benefit	*44*	43%	*35*	66%	*31*	58%	*4*	50%

**Significant differences between athlete populations at p<0.01 for No Benefit*
‡Significant differences between athlete populations at p<0.05 for No Benefit

Table 2: Beliefs about common recovery techniques by population group

		Training				Competition			
		Asia		UK		Asia		UK	
Method	Use	*Response count*	%	*Response count*	%	*Response count*	%	*Response count*	%
Active	No	70	69%	42	79%	69	68%	33	62%
	Yes	32	31%	11	21%	33	32%	20	38%
Swim	No	88	86%	51	96%	96	94%	49	92%
	Yes	14	14%	2	4%	6	6%	4	8%
Sleep*	No	51	50%	47	89%	63	62%	47	89%
	Yes	51	50%	6	11%	39	38%	6	11%
Massage	No	87	85%	50	94%	88	86%	51	96%
	Yes	15	15%	3	6%	14	14%	2	4%
Cold!	No	89	87%	41	77%	95	93%	26	49%
	Yes	13	13%	12	23%	7	7%	27	51%
Heat!	No	89	87%	41	77%	88	86%	34	64%
	Yes	13	13%	12	23%	14	14%	19	36%
Nutrition	No	62	61%	30	57%	70	69%	33	62%
	Yes	40	39%	23	43%	32	31%	20	38%
Hydration$,‡	No	95	93%	41	77%	97	95%	44	83%
	Yes	7	7%	12	23%	5	5%	9	17%
Stretch*	No	79	77%	17	32%	77	75%	17	32%
	Yes	23	23%	36	68%	25	25%	36	68%
Compression*	No	101	99%	37	70%	101	99%	35	66%
	Yes	1	1%	16	30%	1	1%	18	34%
Foam Roll*	No	98	96%	33	62%	101	99%	34	64%
	Yes	4	4%	20	38%	1	1%	19	36%
Psych	No	99	97%	52	98%	102	100%	51	96%
	Yes	3	3%	1	2%	0	0%	2	4%
Rest‡	No	88	86%	47	89%	82	80%	50	94%
	Yes	14	14%	6	11%	20	20%	3	6%
Training	No					102	100%	52	98%
	Yes					0	0%	1	2%

** Significant differences between populations at p<0.01 for both training and competition*
! Significant differences between populations at p<0.01 for competition
$ Significant differences between populations at p<0.01 for training
‡ Significant differences between populations at p<0.05 for competition

Table 3: Adoption of particular recovery strategies by athletes

Method	Belief & Adoption	Asia		UK	
		Response count	%	*Response count*	%
Sleep[*,$]	Belief in method but athlete doesn't use (+/-)	61	60%	46	87%
	Belief & use by athlete (+/+)	41	40%	7	13%
	No belief in method & athlete doesn't use (-/-)	83	81%	53	100%
	No belief in method but athlete uses (-/+)	19	19%	0	0%
Nutrition[$]	Belief in method but athlete doesn't use (+/-)	73	72%	30	57%
	Belief & use by athlete (+/+)	29	28%	23	43%
	No belief in method & athlete doesn't use (-/-)	82	80%	51	96%
	No belief in method but athlete uses (-/+)	20	20%	2	4%
Compression[*,$]	Belief in method but athlete doesn't use (+/-)	101	99%	42	79%
	Belief & use by athlete (+/+)	1	1%	11	21%
	No belief in method & athlete doesn't use (-/-)	101	99%	44	83%
	No belief in method but athlete uses (-/+)	1	1%	9	17%
Active	Belief in method but athlete doesn't use (+/-)	70	69%	34	64%
	Belief & use by athlete (+/+)	32	31%	19	36%
	No belief in method & athlete doesn't use (-/-)	89	87%	50	94%
	No belief in method but athlete uses (-/+)	13	13%	3	6%
Contrast[*,$]	Belief in method but athlete doesn't use (+/-)	101	99%	42	79%
	Belief & use by athlete (+/+)	1	1%	11	21%
	No belief in method & athlete doesn't use (-/-)	101	99%	44	83%
	No belief in method but athlete uses (-/+)	1	1%	9	17%
Ice[*]	Belief in method but athlete doesn't use (+/-)	94	92%	32	60%
	Belief & use by athlete (+/+)	8	8%	21	40%
	No belief in method & athlete doesn't use (-/-)	92	90%	46	87%
	No belief in method but athlete uses (-/+)	10	10%	7	13%

[*] *Significant differences between belief groups of populations at p<0.01*
[$] *Significant differences between non belief groups of populations at p<0.01*

Table 4: Belief and use of recovery strategies

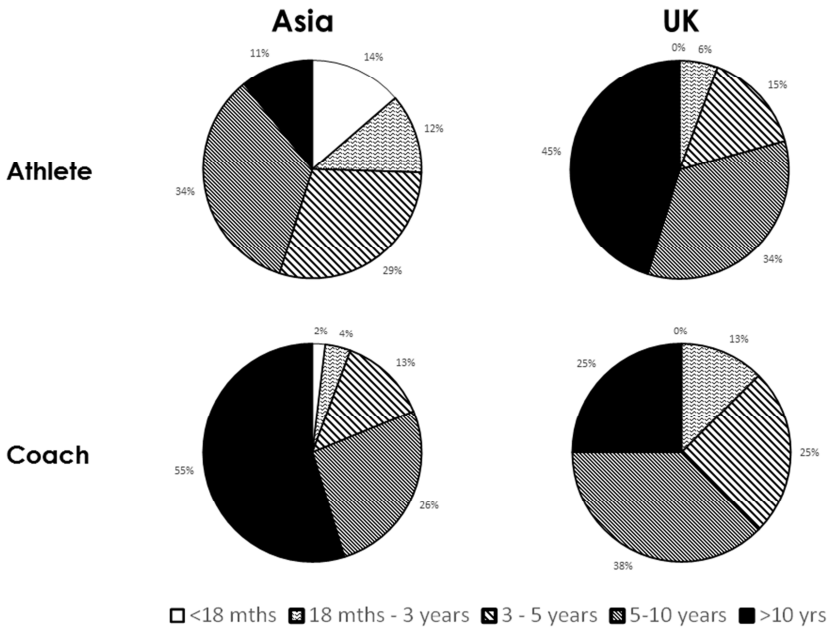

Figure 2: Why athletes recover the way they do (Asia on left, UK on right)

Figure 3: How athletes know they have recovered (Asia on left, UK on right)

Highlights

- Adolescent athletes prioritise active recovery, nutrition and sleep in their beliefs.
- Behaviour does not always match their beliefs
- The coaches role in dictating recovery behaviours to adolescents merits investigation

Conflicts of Interest Statement for Physical Therapy in Sport

Manuscript title: Practices & Attitudes towards Recovery in Elite Asian & UK Adolescent Athletes

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Ethical Statement for Physical Therapy in Sport

I testify on behalf of all co-authors that our article submitted to Physical Therapy in Sport:

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All authors: Andrew Murray, Anthony P. Turner, John Sproule, Marco Cardinale

1) this material has not been published in whole or in part elsewhere;
2) the manuscript is not currently being considered for publication in another journal;
3) all authors have been personally and actively involved in substantive work leading to the manuscript, and will hold themselves jointly and individually responsible for its content.

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